T-38 ANTHRO RESEARCH

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OUTLINE

- **Background on Anthro, Accommodation Expansion, and Exceptions To Policy/Waivers**

- **T-38A Accommodation Levels**

- **Follow-On Fighters/Bombers**

- **NASA Ejection Seat Upgrade**

- **T-38C Issues**

Why Anthropologists ?

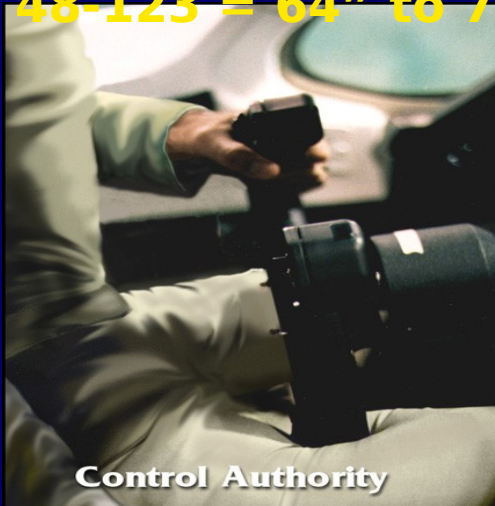Unwittingly, Palmer stepped out of the jungle and into headhunter folklore forever.

Background

Current Pilot Population Accommodation

(AFI 48-123 = 64" to 77" Height and 34" to 40" Sitting Height)

External Vision

Control Authority

Reach to Rudders

Leg Clearance

Body Clearances

Reach To Controls

Background
JPATS

- **1994 - Congress directed that the JPATS would accommodate 80% to 95% of female military population.**

JPATS Size Range:
6'5" to 4'10"

- **This translates to a 58" standing height and**

Design Ranges
(Range From Smallest to Largest)

TRADITIONAL

VS

JPATS SPECIFICATION RANGES

	JPATS	5-95% Male
Sitting Height	4.1"	9.0"
Leg Length	6.7"	13.8"
Arm Reach	4.4"	9.9"

Background

Small Military Subject (5'- 0") in the T-38A
Inertial reels locked

Glareshield line projected to pilot's head

Missed full rudder throw by several inches

Missed reach to full throttle by several inches

Missed forward stick by several inches

Reminder

Important Distinction

1) Male and Female PILOT population groups – meet current requirements

2) Male and Female MILITARY groups – Do Not meet current requirements

Percentages of Accommodation will be shown for each but confuse many people

Requirement:

Vision over the nose to equal -11 degrees

- **Original design eye line**

- **Base of pitot tube**

- **Verified through study flights - Minimum for no-flap landing and**

(T-1 Example)

Percent Accommodated:

	Military Population	Pilot Population
Male	**90%**	**94%**
Female	**42%**	**86%**

T-38A Results: Rudders Minimum Leg Length = 43"

Requirement:

Full rudder with distinct and separate full brake input

- **To recover from a blown tire on landing**

- **Pilot tightly restrained**

Percent Accommodated:

	Military Populati	Pilot Populati
Male	**95%**	**97%**
Female	**46%**	**81%**

Requirement:

REACH TO RETRACT FULL THROTTLES

- INERTIAL REELS LOCKED

- REPRESENTS WORSE CASE CONDITIONS

Missed reach to full throttle by several inches

Percent Accommodated

	Military Population	Pilot Population
Male	98%	98%
Female	40%	77%

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Red = Hold To Current 34 - 40" Sitting Height and   64 - 77" Stature Requirements
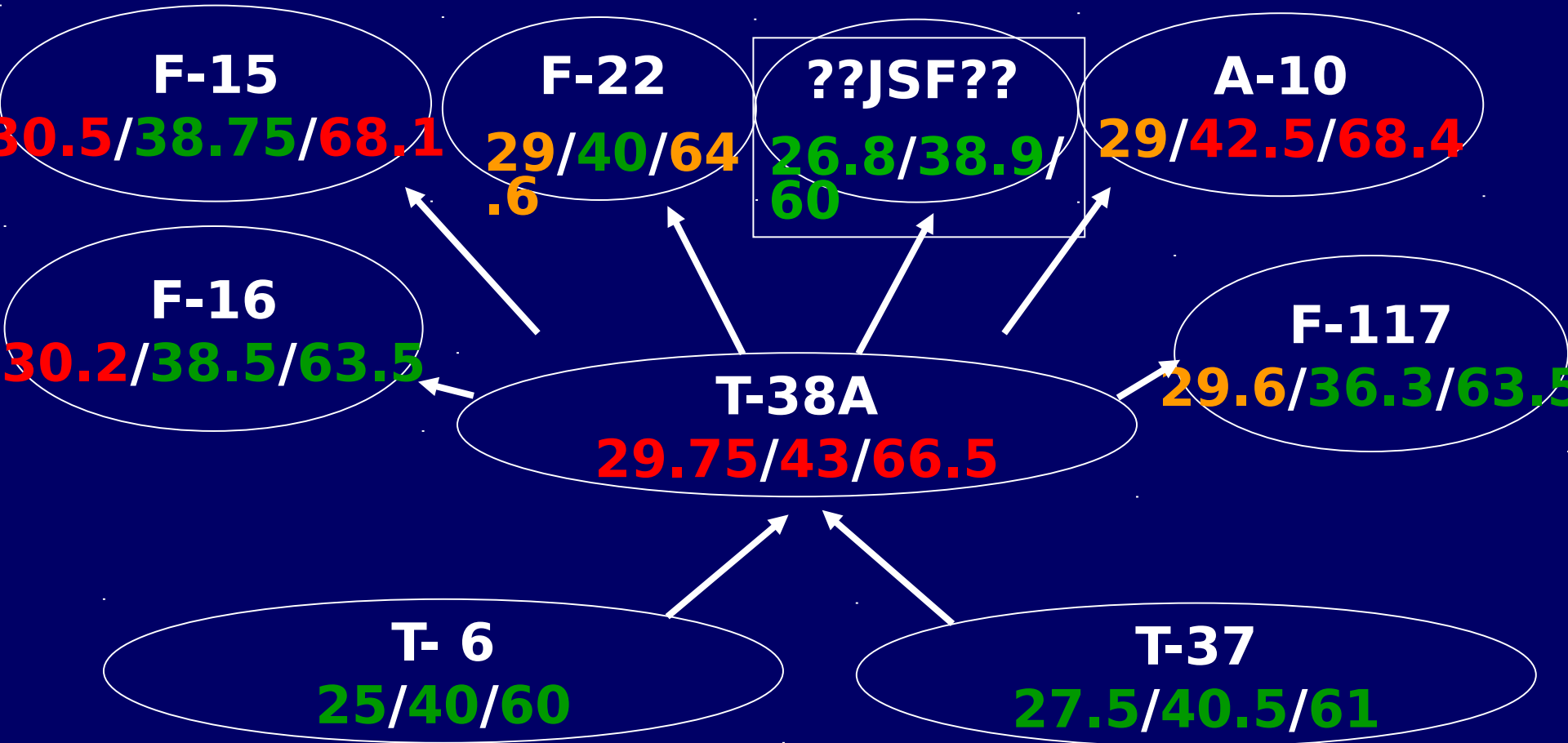**-** *No Change Possible*

Yellow = Parameters Within 1" of Current Small Pilot
- *A Little Room for Change*

Green =Parameters More Than 1-inch from Current Small Pilot
- *Lots of Change Possible*
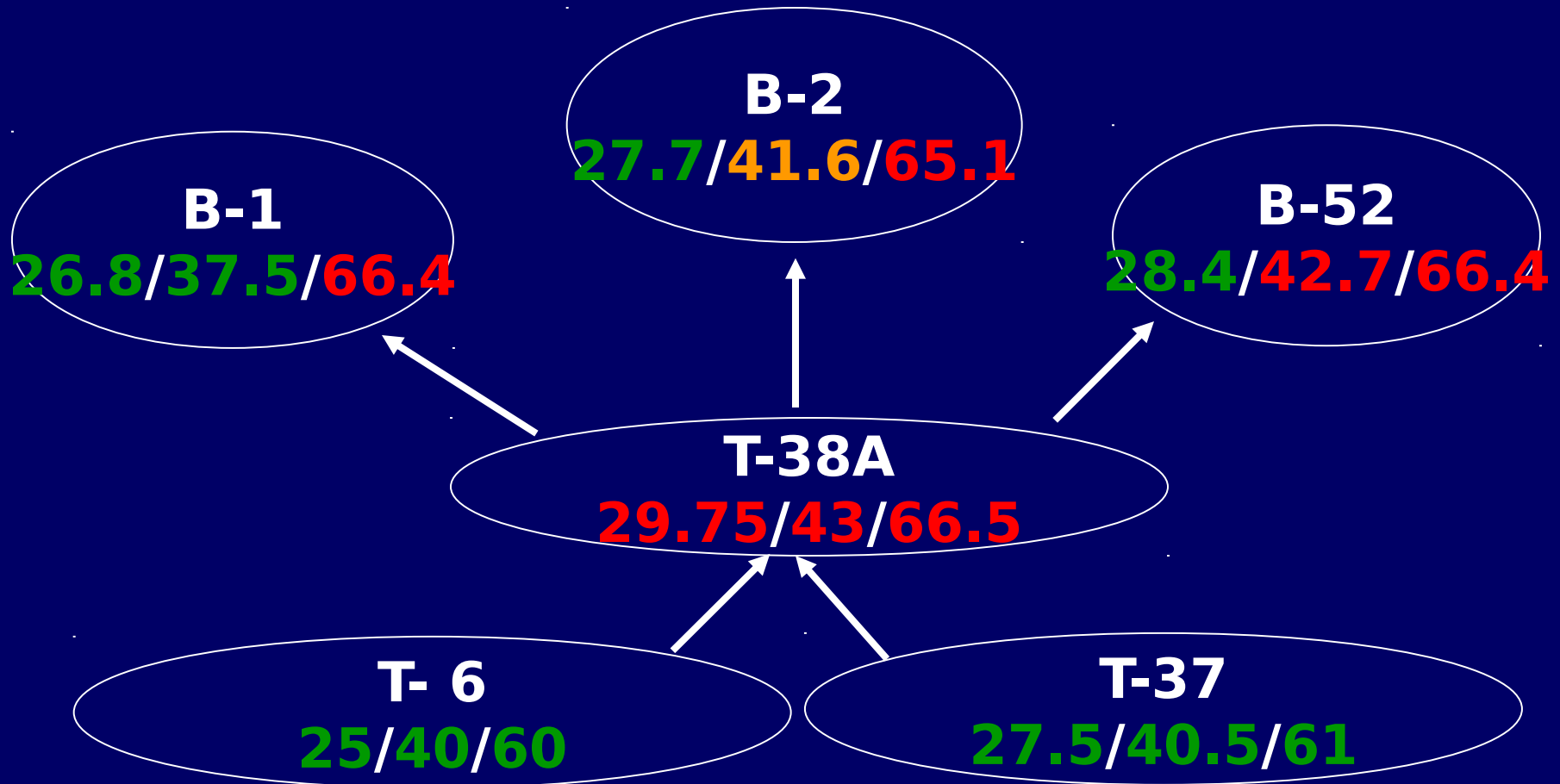
**Current Small Pilot
Eye=29.5/Leg=42.5/Arm=64.6**

Results: Small Pilots in Fighters

F-15
30.5/38.75/68.1

F-22
29/40/64.6

??JSF??
26.8/38.9/60

A-10
29/42.5/68.4

F-16
30.2/38.5/63.5

T-38A
29.75/43/66.5

F-117
29.6/36.3/63.5

T- 6
25/40/60

T-37
27.5/40.5/61

Current Small Pilot
Eye=29.5/Leg=42.5/Arm=64.6

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Results: Small Pilots in Bombers

B-2
27.7/41.6/65.1

B-1
26.8/37.5/66.4

B-52
28.4/42.7/66.4

T-38A
29.75/43/66.5

T- 6
25/40/60

T-37
27.5/40.5/61

Current Small Pilot
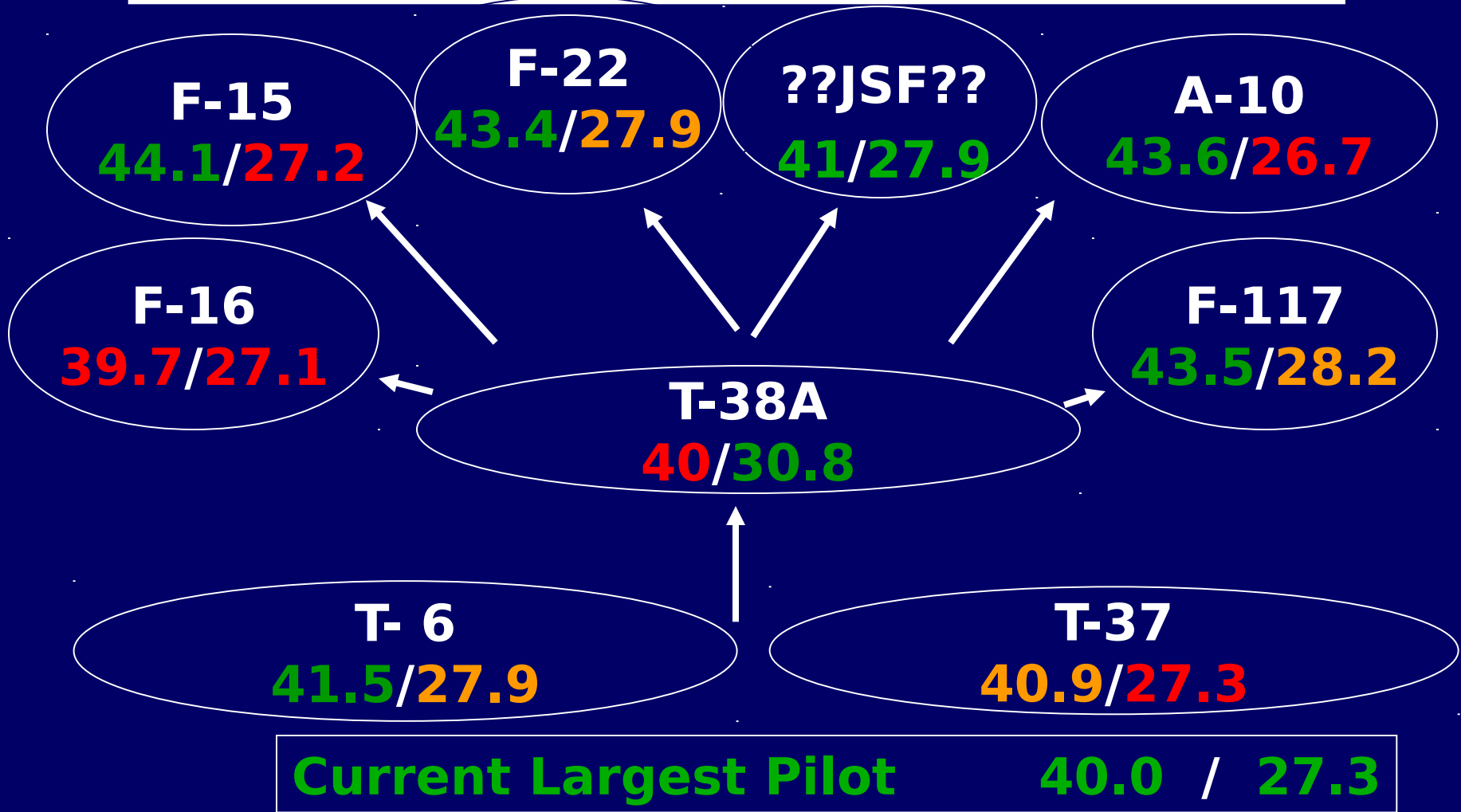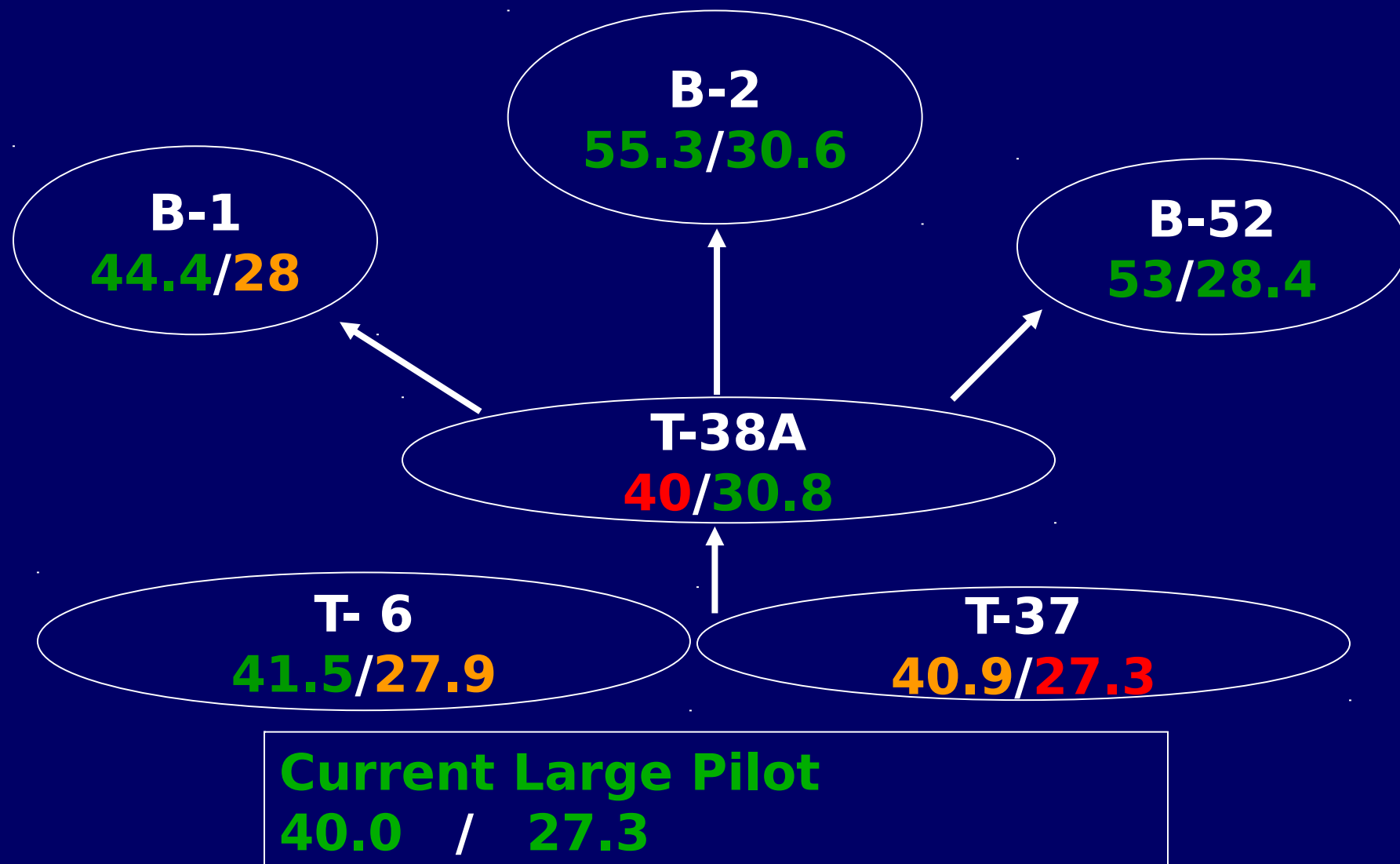Eye=29.5/Leg=42.5/Arm=64.6

T-38A
OVERHEAD CLEARANCE

- **40 INCH SITTING HEIGHT WILL HIT CANOPY - DEPENDING ON HELMET FIT AND POSTURE**

- **HOW MUCH CLEARANCE SPACE IS NEED FOR -G FLIGHT?**
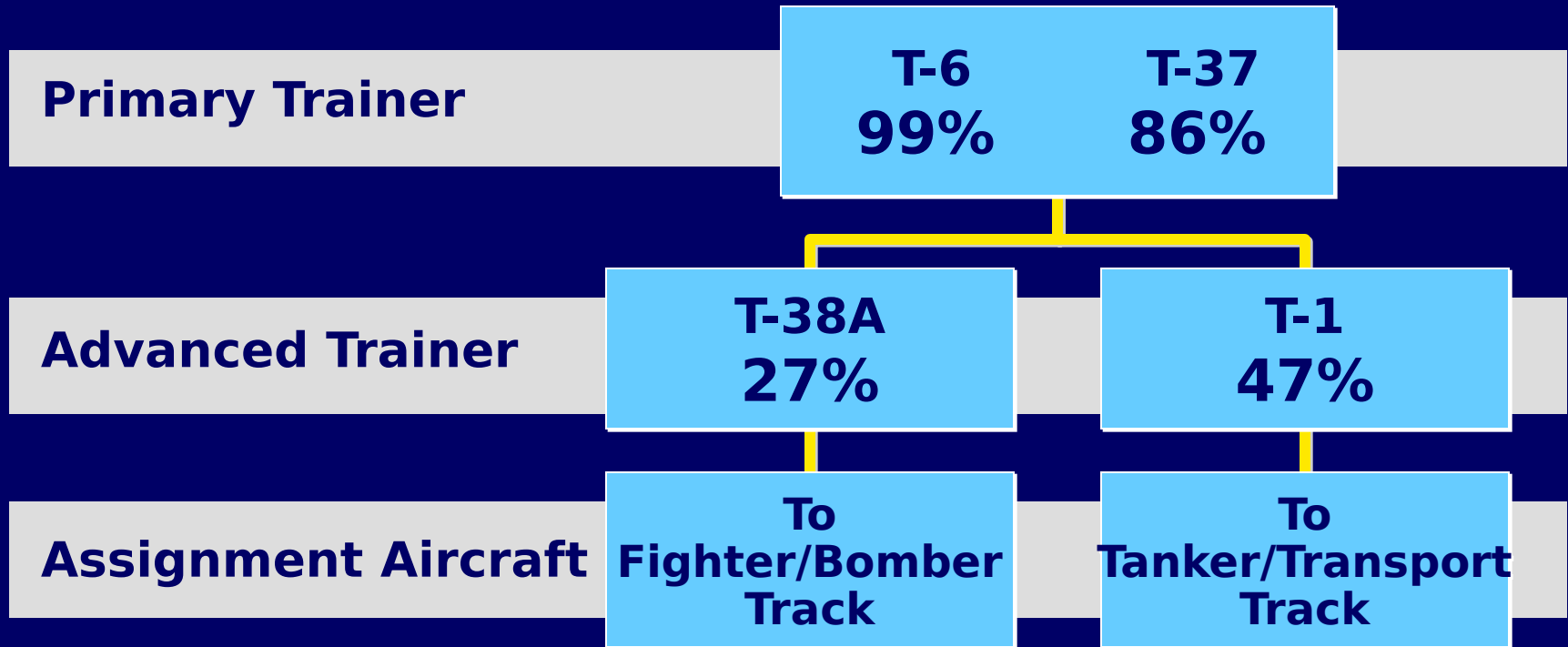
Results: Large Pilots in Fighters

F-15
44.1/27.2

F-22
43.4/27.9

??JSF??
41/27.9

A-10
43.6/26.7

F-16
39.7/27.1

F-117
43.5/28.2

T-38A
40/30.8

T- 6
41.5/27.9

T-37
40.9/27.3

Current Largest Pilot   40.0 / 27.3

Results: Large Pilots in Bombers

B-2
55.3/**30.6**

B-1
44.4/**28**

B-52
53/**28.4**

T-38A
40/**30.8**

T- 6
41.5/**27.9**

T-37
40.9/**27.3**

Current Large Pilot
40.0   /   27.3

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Trainer Summary – Effect on Females

Accommodation Percentages: **Female Military Population**

Primary Trainer	**T-6** **99%**	**T-37** **86%**
Advanced Trainer	**T-38A** **27%**	**T-1** **47%**
Assignment Aircraft	**To Fighter/Bomber Track**	**To Tanker/Transport Track**

Trainer Summary – Effect on Males

Accommodation Percentages: Male Military Population

Primary Trainer	**T-6 99.9%**	**T-37 99.7%**
Advanced Trainer	**T-38A 87%**	**T-1 92%**
Assignment Aircraft	**To Fighter/Bomber Track**	**To Tanker/Transport Track**
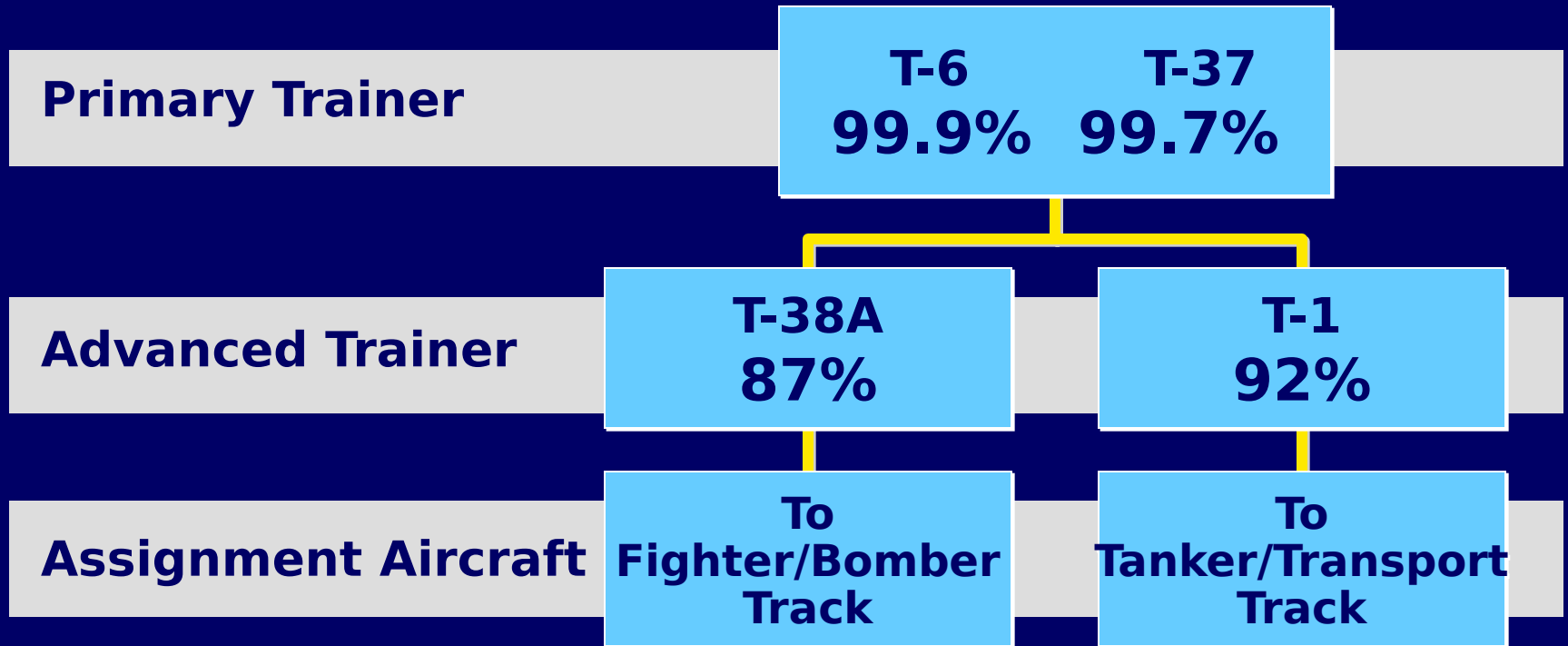
NASA T-38N

- **3 Anthro Evals performed during source selection for NASA**

- **ASC/EN supported Ejection seat testing**

- **AFRL digitally evaluated effect of this seat in the T-38C**

Limit Differences in T-38A and T-38N

!! If stick and Rudder Issues are Acceptable !!

Anthropometric Limits of Accommodation		
	USAF T-38A (Northrop Seat)	**NASA T-38N (MB Seat)**
Small Issues (Forward Cockpit):		
Min. Eye Height (Vision)	**29.8"**	**28.3"**
Min. Span (Reach)	**66.7"**	**61.3"**
Min. Comboleg[1] (Rudders)	**43.0"**	**41.7"**
Large Issues:		
Max. Sitting Height (Aft Cockpit)	**40.0"**	**41.4"**
Max. Buttock Knee (Forward Cockpit)	**30.8"**	**29.0"**

Accommodation Percentages

MILITARY POPULATIONS

Statistical Sample	Aircraft	Small Issues			Small Total[1]	Large Issues		Large Total[2]	ALL Total[3]
		Vision	Rudder	Reach		KneeClr	HeadClr		
Military Females (N=851)	T-38A	41.7	45.3	37.3	**27.2**	100.0	100.0	**100.0**	**27.2**
	NASA T-38	82.6	75.8	93.4	**69.8**	100.0	100.0	**100.0**	**69.8**
Military Males (N=1301)	T-38A	89.6	95.2	97.1	**86.9**	100.0	99.7	**99.7**	**86.6**
	NASA T-38	99.4	99.5	100.0	**99.0**	100.0	99.8	**99.8**	**98.8**

!! If Stick and Rudder Issues are Acceptable !!

PILOT POPULATIONS

Statistical Sample	Aircraft	Small Issues			Small Total[1]	Large Issues		Large Total[2]	ALL Total[3]
		Vision	Rudder	Reach		KneeClr	HeadClr		
Female Pilots (N=365)	T-38A	85.7	81.3	75.2	**63.4**	100.0	100.0	**100.0**	**63.4**
	NASA T-38	100.0	100.0	100.0	**100.0**	100.0	100.0	**100.0**	**100.0**
Male Pilots (N=1229)	T-38A	94.3	96.6	98.7	**91.8**	100.0	100.0	**100.0**	**91.8**
	NASA T-38	100.0	100.0	100.0	**100.0**	100.0	100.0	**100.0**	**100.0**

T-38A
Stick Throw Issue
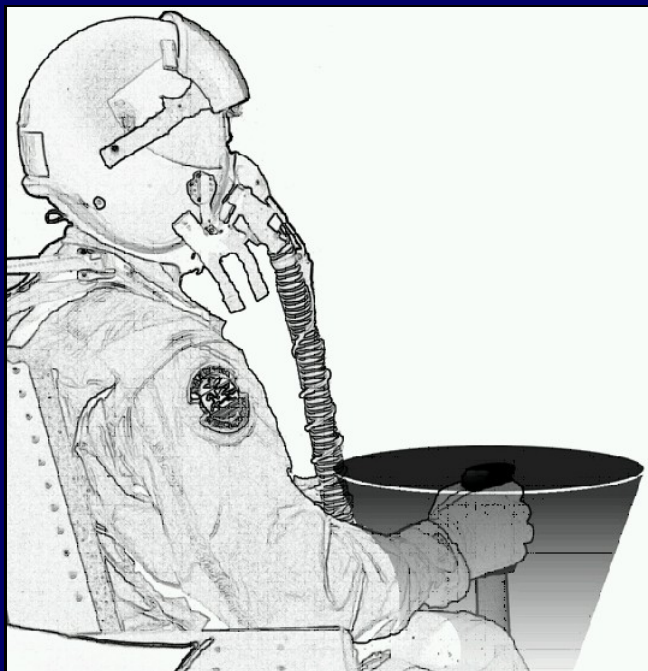
- HALF OF OUR TEST SUBJECTS HAD STICK CLEARANCE PROBLEMS FULL-UP.

PROBLEMS INCREASE IF WE :

- RAISE THE PILOT

- MOVE THE PILOT FORWARD

Stick Throw Issue

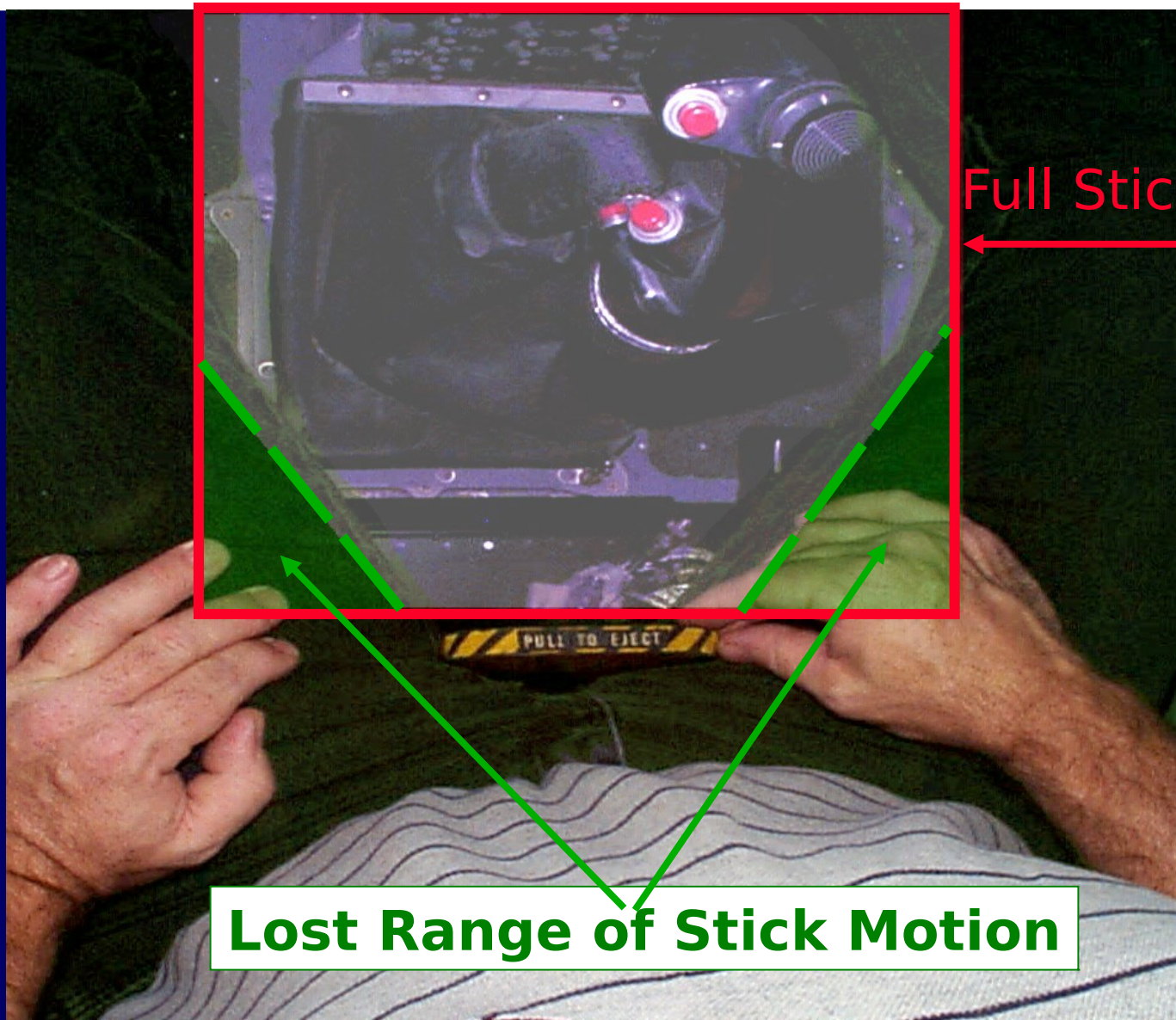**Stick Held Aft/Left**
10 1/2 Inches from Bulkhead

Full Aft/Left Range
8 1/2 Inches from Bulkhead
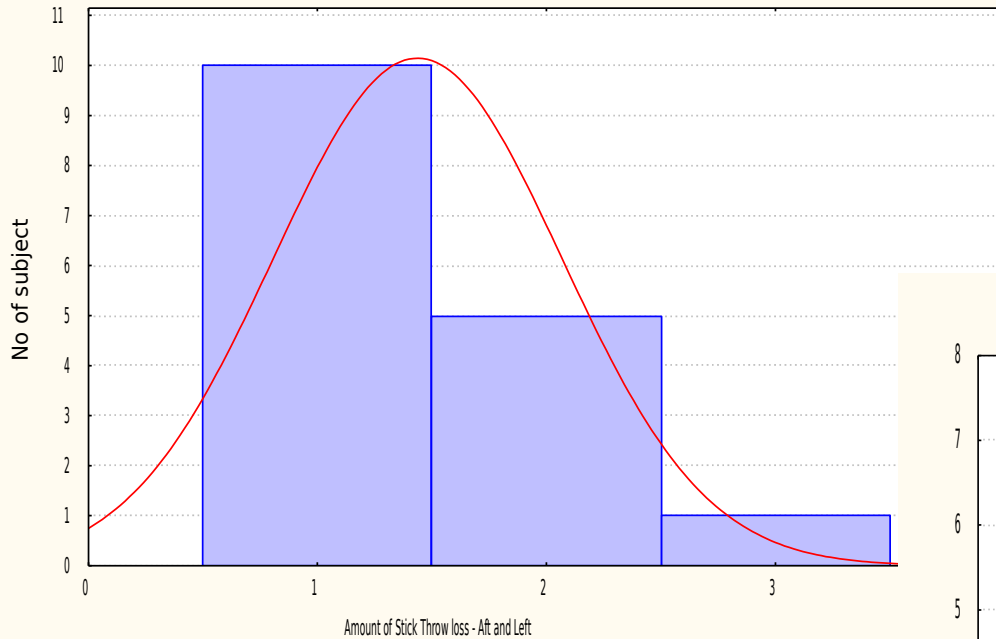
ISSUE: Loss of Stick Throw
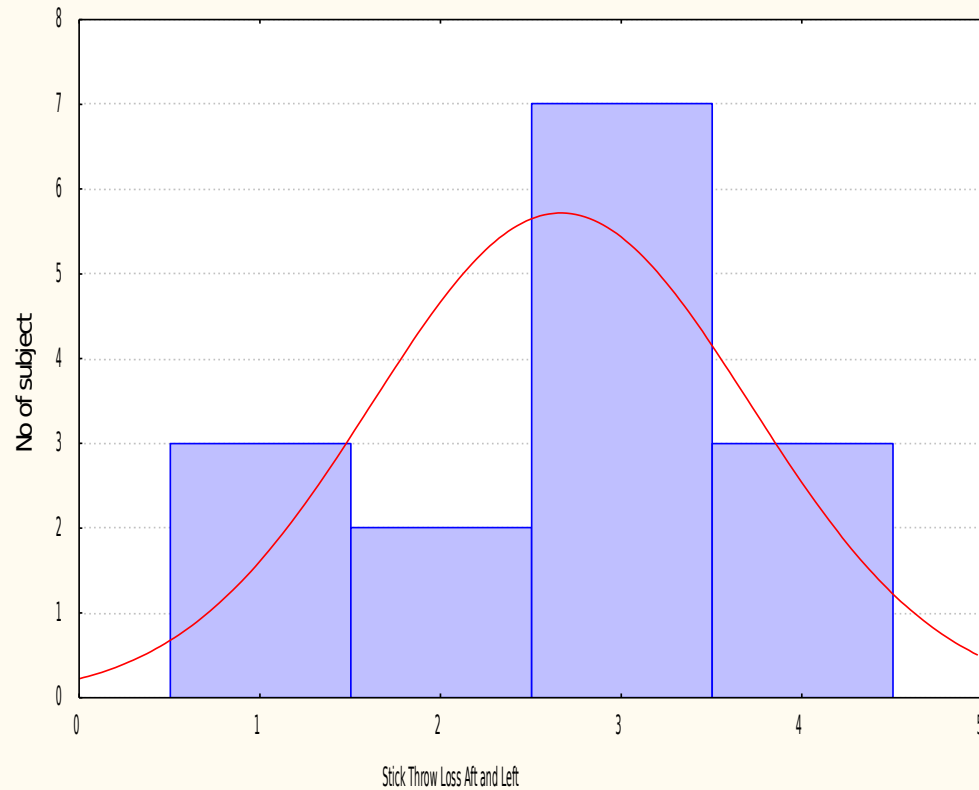

Full Stick Range

Lost Range of Stick Motion

PULL TO EJECT

Difference between Martin-Baker and Northrop Seats for Stick Throw
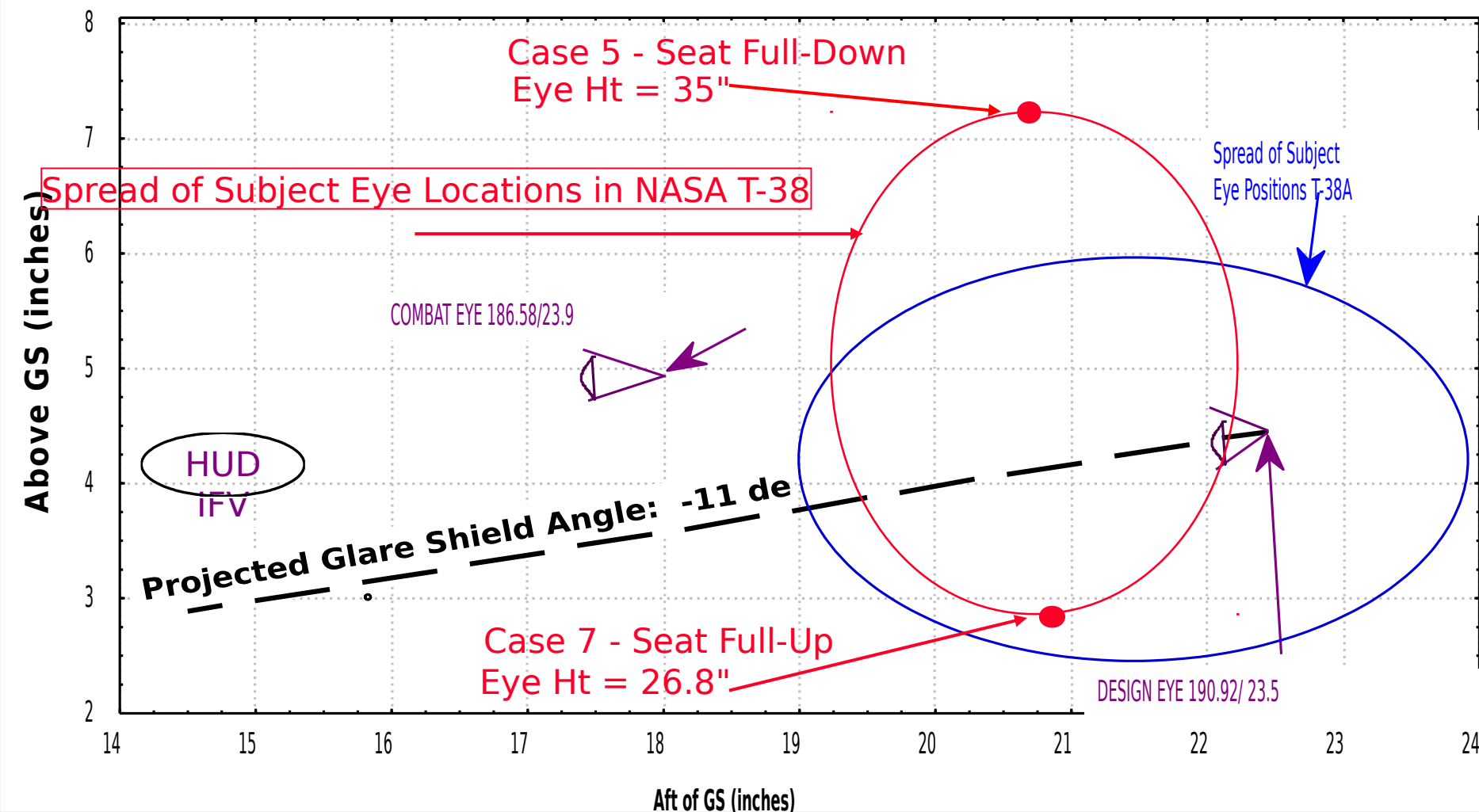
Ejection Handle Issue

Rudder Issue

T-38 Eye Positions

FWD Cockpit: Eye Position Location

With Respect to Glare Shield (GS) Edge

T-38C-HUD FOV – Early in Design

- **LARGE PILOTS MUST LEAN FORWARD FOR IFOV**

- **5% (1950) MALE PILOT JUST SEES -11 ONV LINE AND HUD**

- **SPO STILL WORKING DESIGN EYE ISSUE - MORE INVOLVED THAN ANTHRO**

The Way Forward

- **Flight Tests**

    - Stick "Operational range" – What is needed?

- **Simulator Flight Tests**

    - Independent Rudder and Brake Application

- **Investigate Accommodation Improvement with ACESII Upgrade Cushions**

The Way Forward

- **Accurate Fore-body at WPAFB**

  – **Rough T-38C configuration – HUD, Throttle, and Rudders**

- **Install very adjustable seat that can move to a wide range of seat positions.**

  -**Determine what can be done without Airframe Modification**

- **All proposed contractor designs evaluated in the   same mock-up**

Percentile Population

If 5th to 95th percentile limits are applied to each of the following:

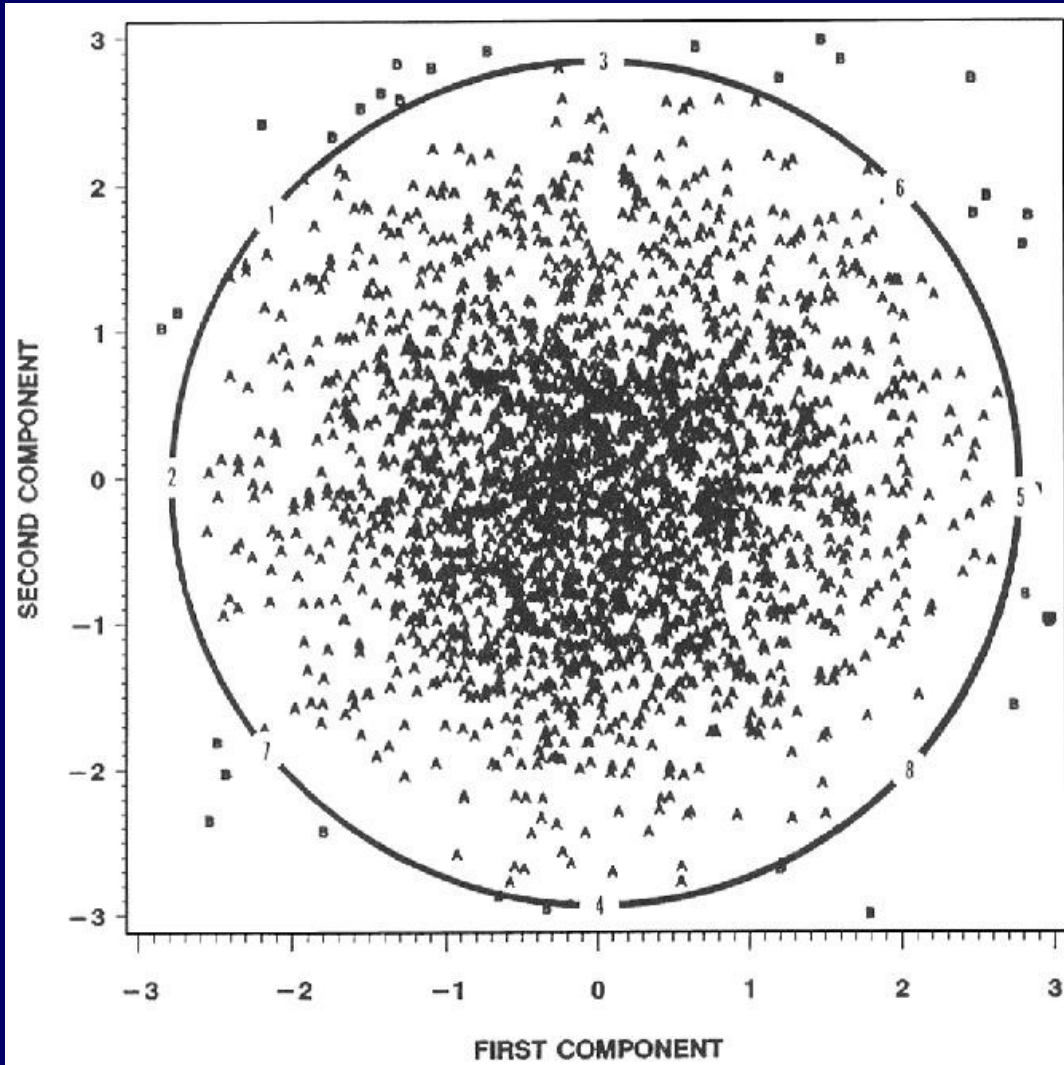|	0-5	95-100	Remaining Percentage
Sitting Ht.			90%
Butt-Knee Lth			82%
Knee Ht. Sit.			78%
Shoulder Brth			71%
Functional Reach			67%

QUESTIONS?

Multivariate Approach

- **Each axis on graph represents several measurements**

- **95% of the population is inside the circle**

- **The 8 model points (or test individuals) located on the perimeter are more extreme than all individuals inside**